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Chikusa et al.

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(54) **CONNECTOR WITH LINEARLY MOVABLE OPERATING MEMBER THAT IS MOVABLE OPTIONALLY IN OPPOSITE FIRST AND SECOND MOVING DIRECTIONS FOR CONNECTING THE CONNECTOR TO A MATING CONNECTOR**

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(51) **Int. Cl.**

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H01R 13/629	(2006.01)
H01R 13/428	(2006.01)
H01R 13/627	(2006.01)

(52) **U.S. Cl.**

CPC ***H01R 13/62927*** (2013.01); ***H01R 13/428*** (2013.01); ***H01R 13/6271*** (2013.01); ***H01R 13/62955*** (2013.01); ***H01R 13/62977*** (2013.01)

(58) **Field of Classification Search**

CPC H01R 13/62933; H01R 13/62938; H01R 13/62955; H01R 13/62988

USPC 439/157

See application file for complete search history.

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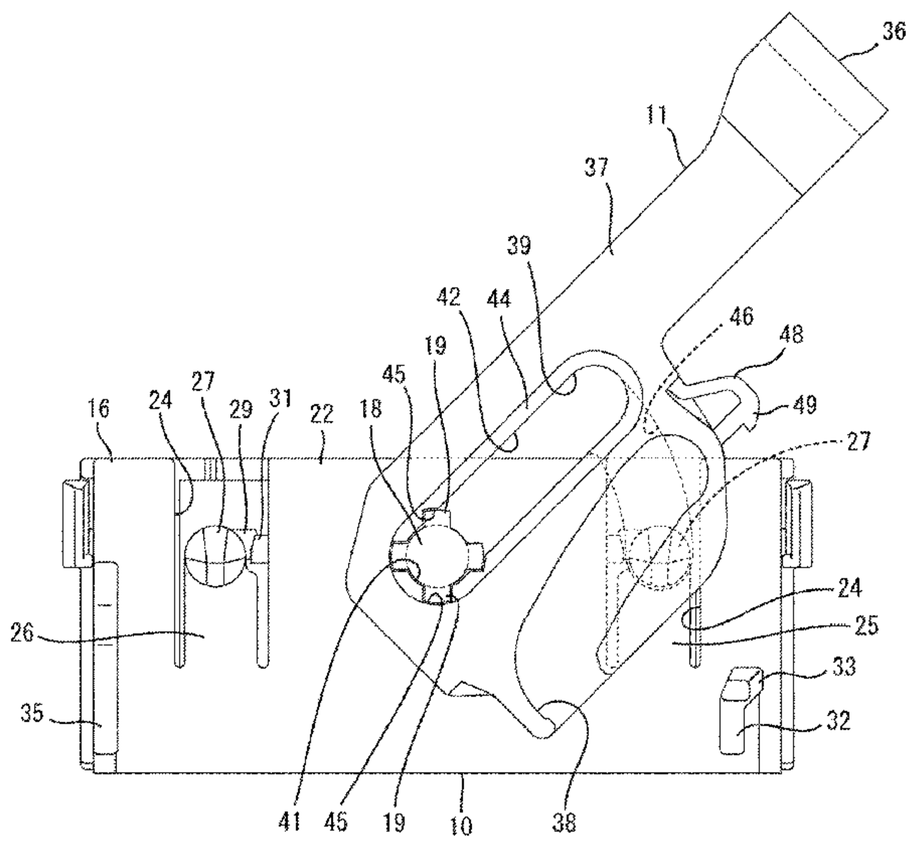
(57) **ABSTRACT**

An operating member (**11**) is displaceable to an assembled position, an initial position and a connection position with respect to a housing (**10**) and proceeds with a connecting operation of the housing and a mating housing (**12**) by cam engagement with the mating housing (**12**) when being displaced from the initial position to the connection position. The housing (**10**) includes resilient locks (**25**, **26**) configured to restrict a displacement of the operating member (**11**) in a direction opposite to that from the assembled position toward the initial position by resiliently locking the operating member (**11**) at the assembled position and restrict a displacement of the operating member (**11**) in a return direction from the initial position to the assembled position by resiliently locking the operating member (**11**) at the initial position.

1 Claim, 16 Drawing Sheets



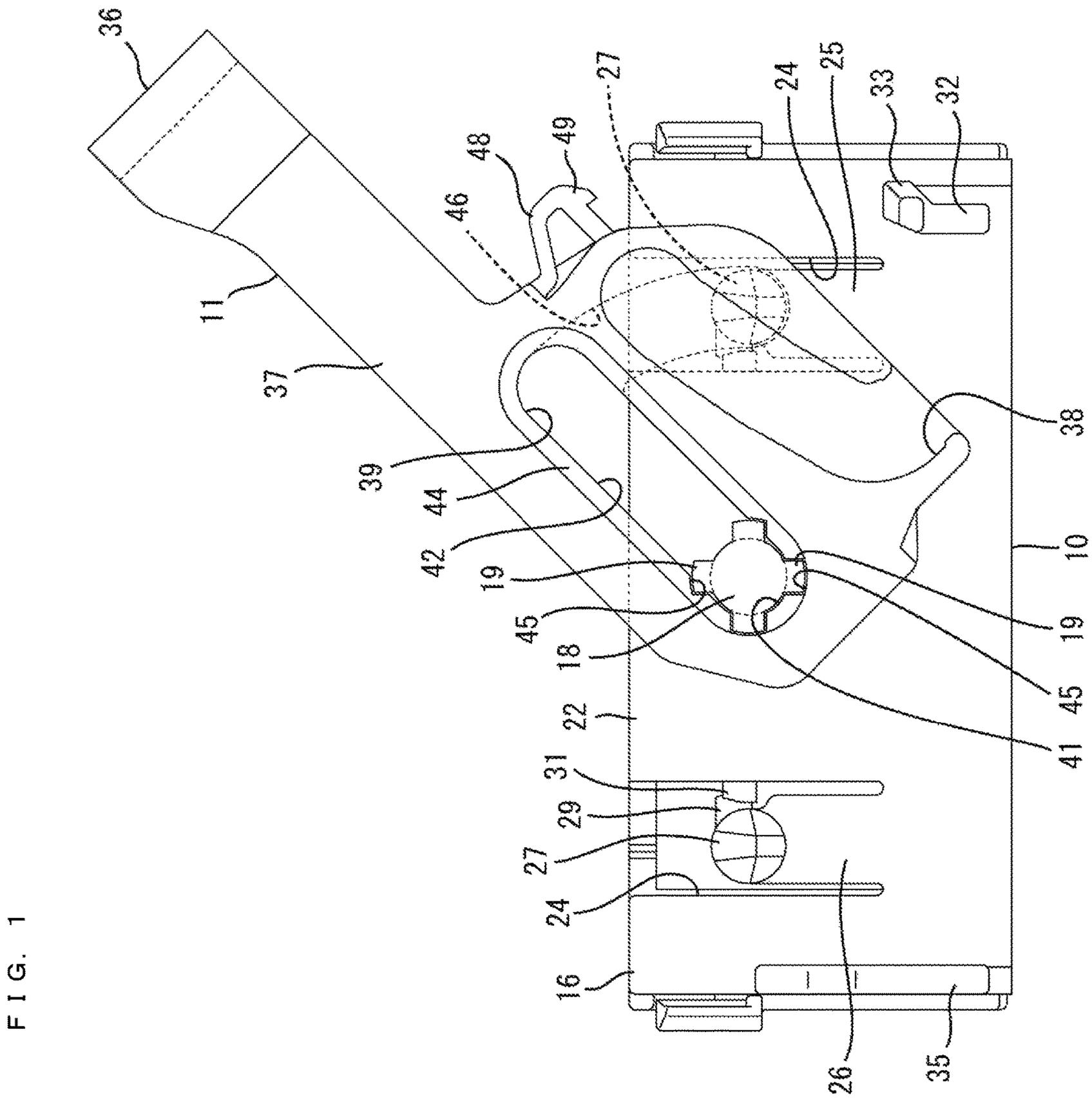

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FIG. 1

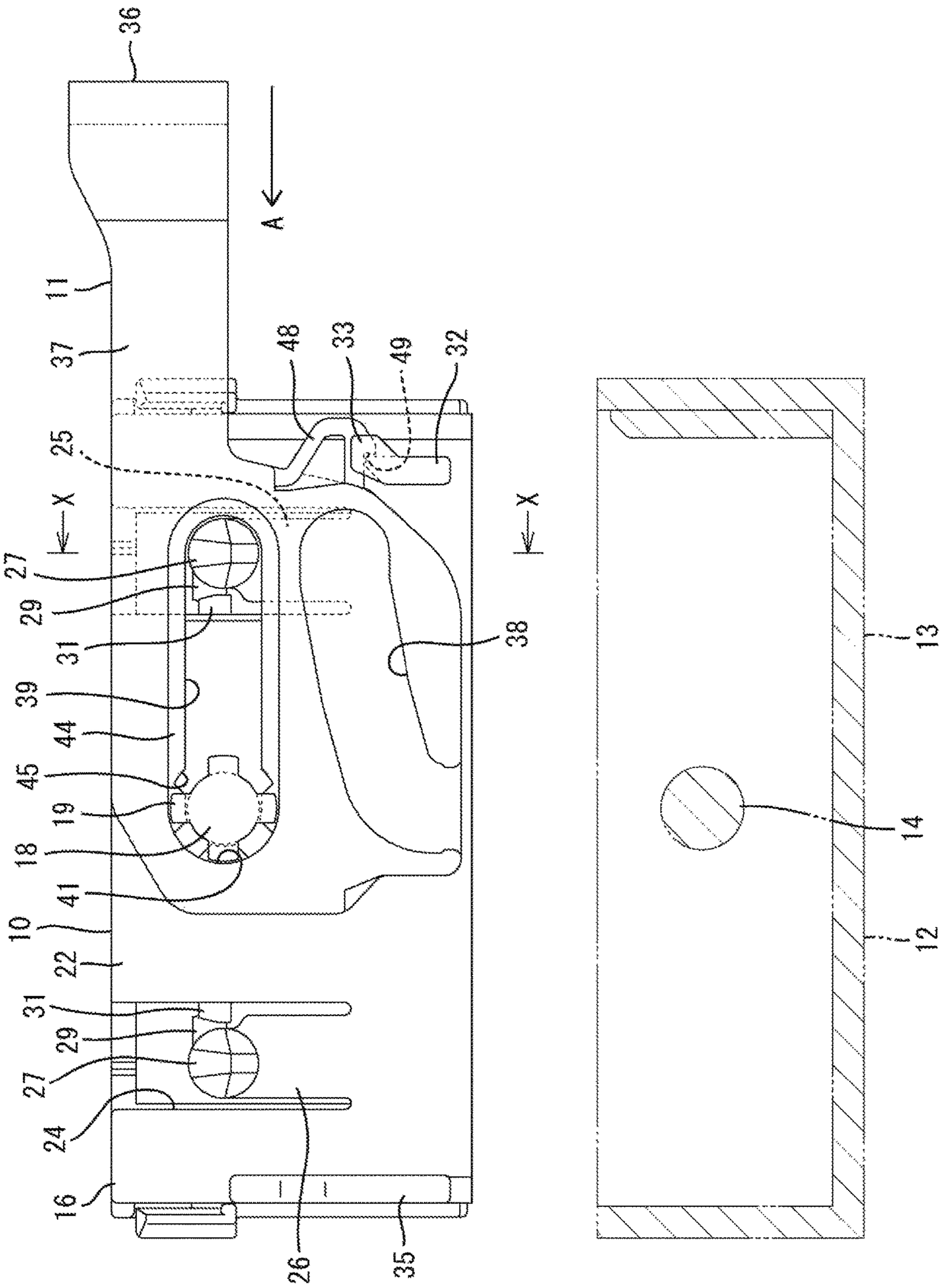
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FIG. 2

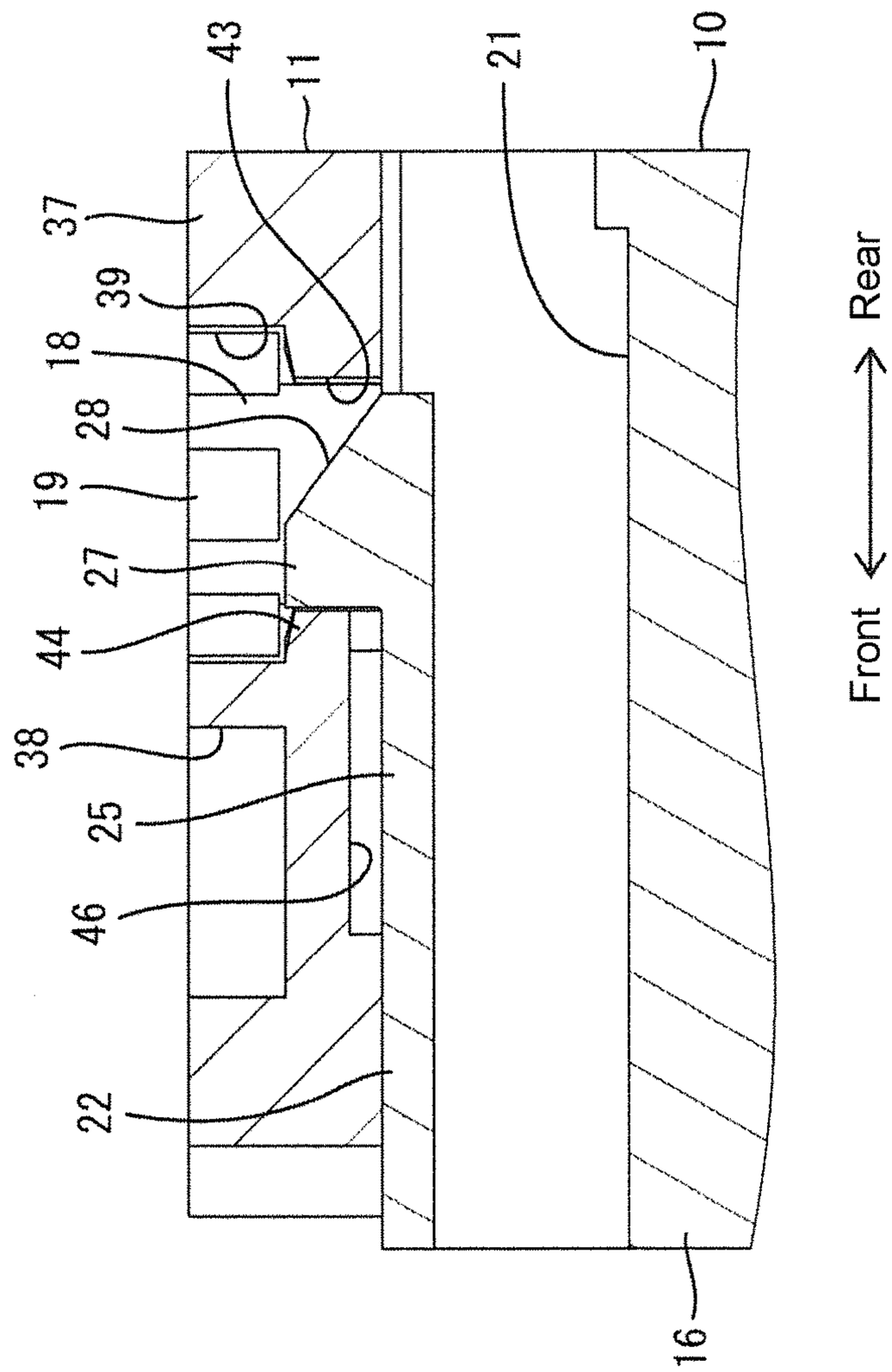
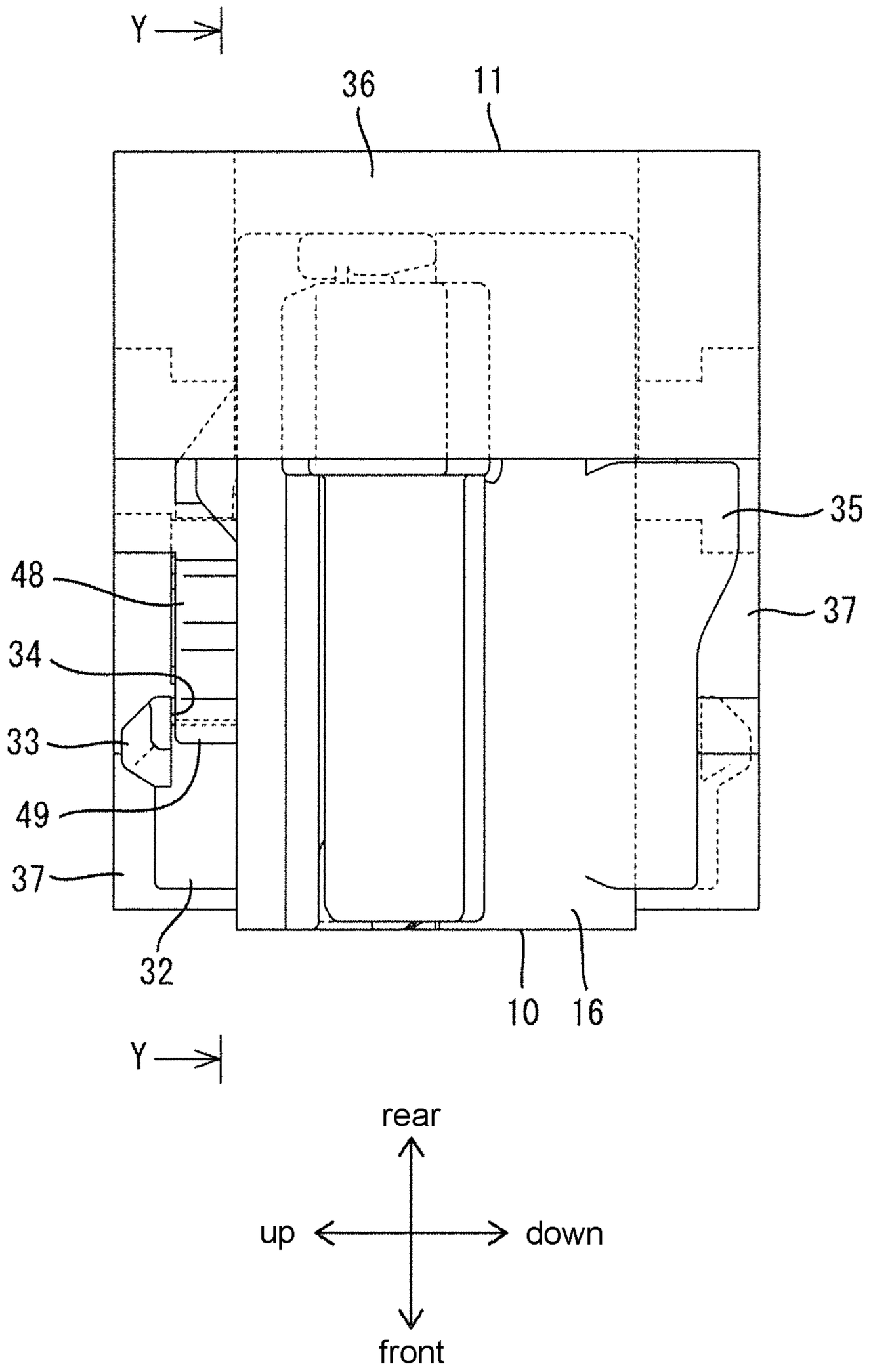
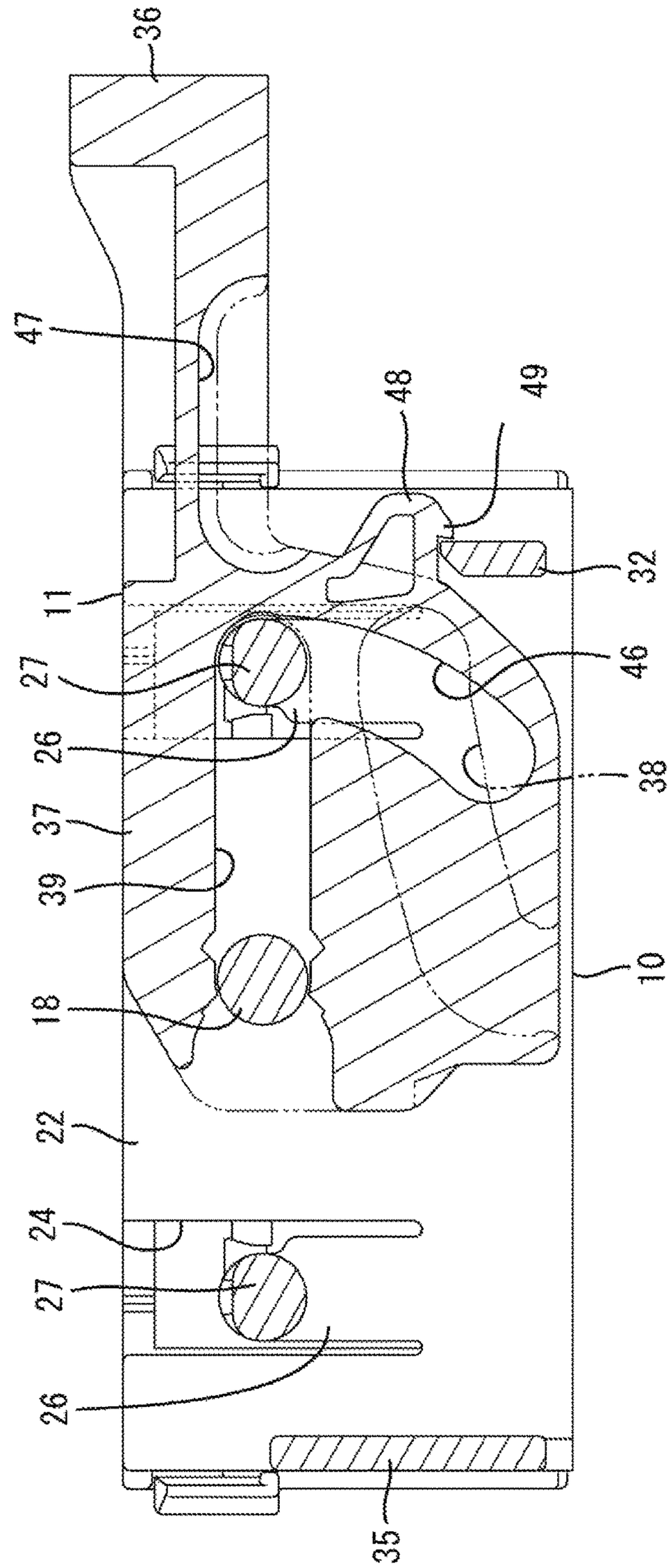


FIG. 3

FIG. 4





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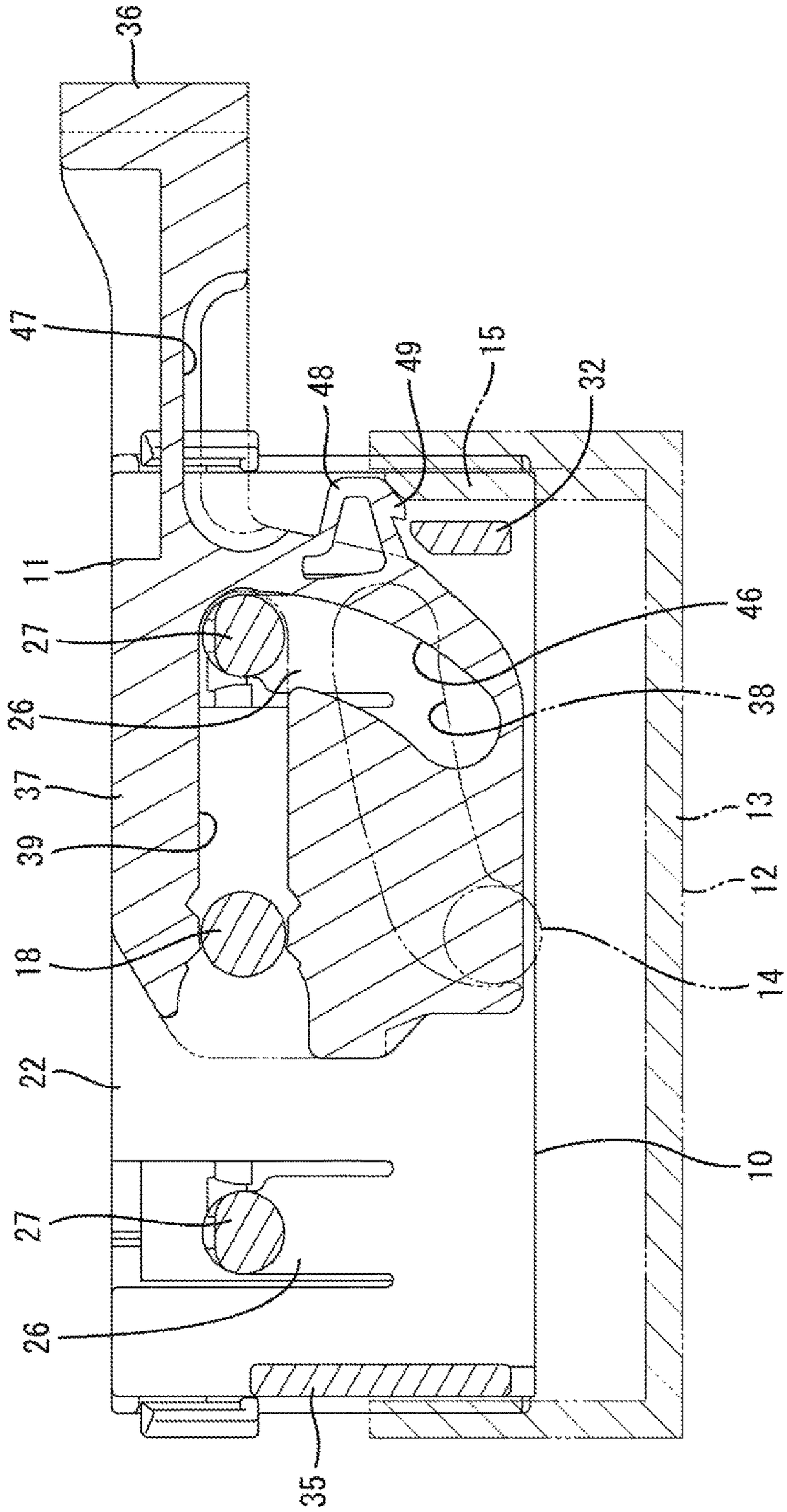

FIG. 6

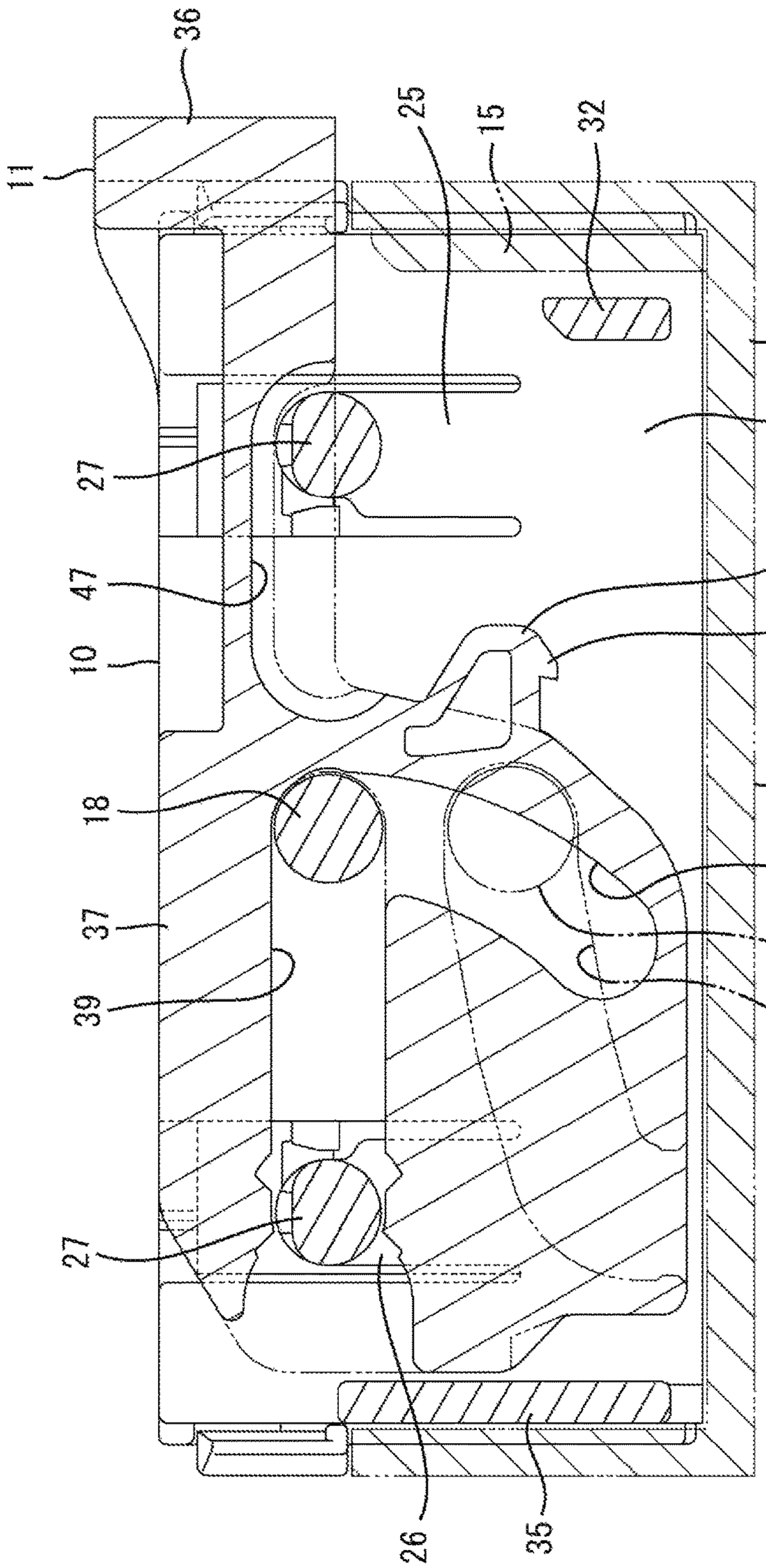

FIG. 7

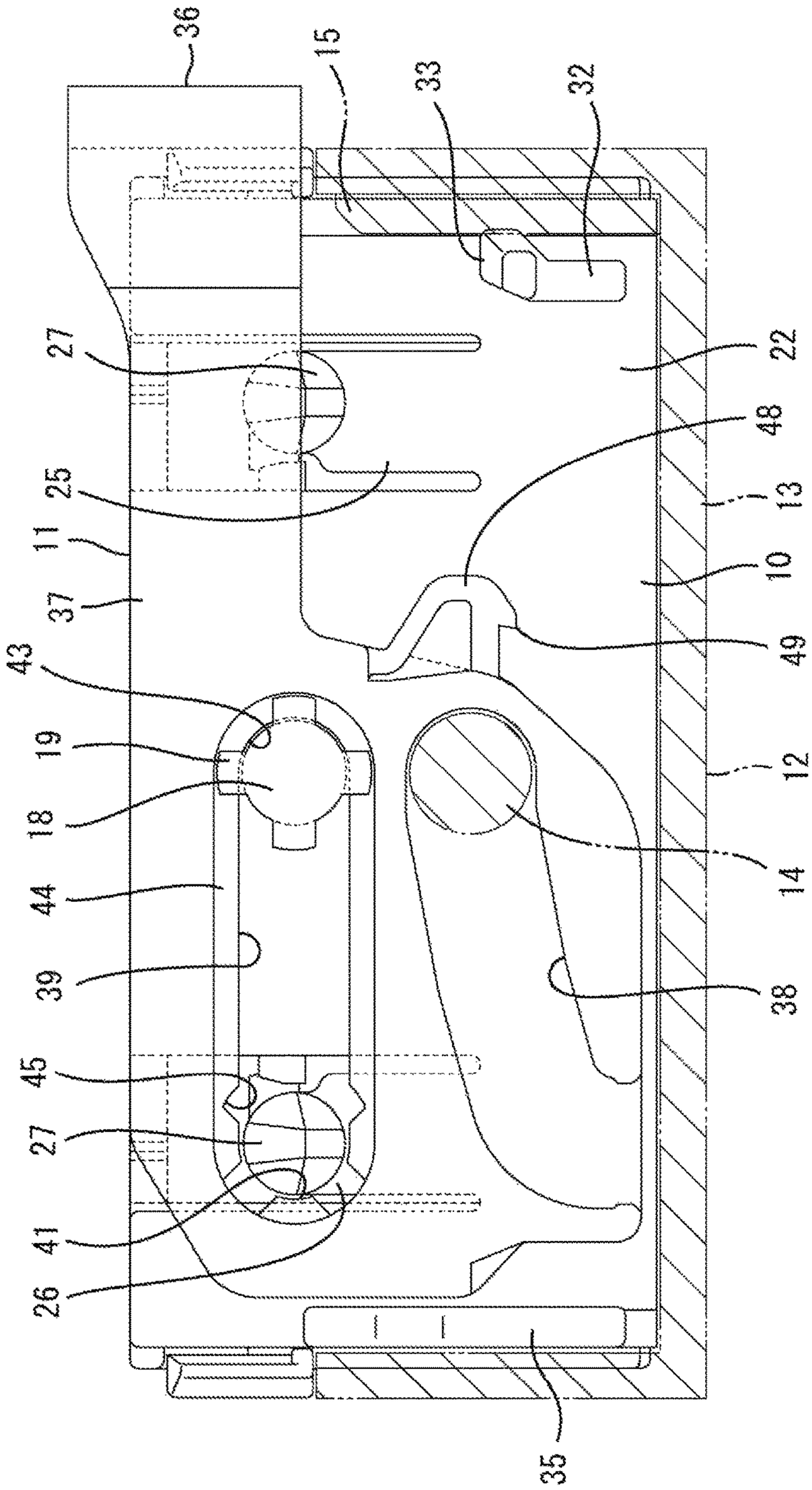
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FIG. 8

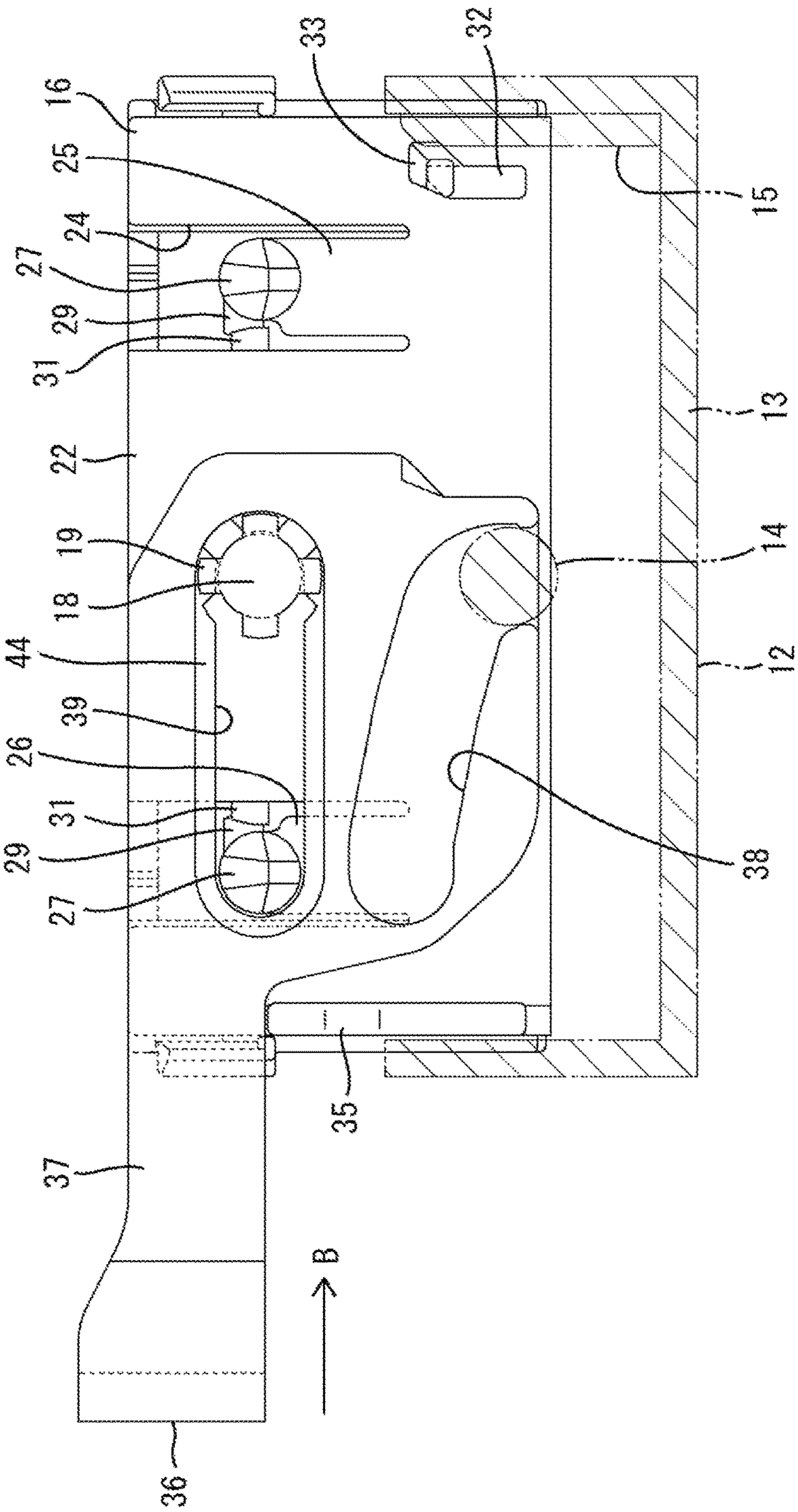
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FIG. 9

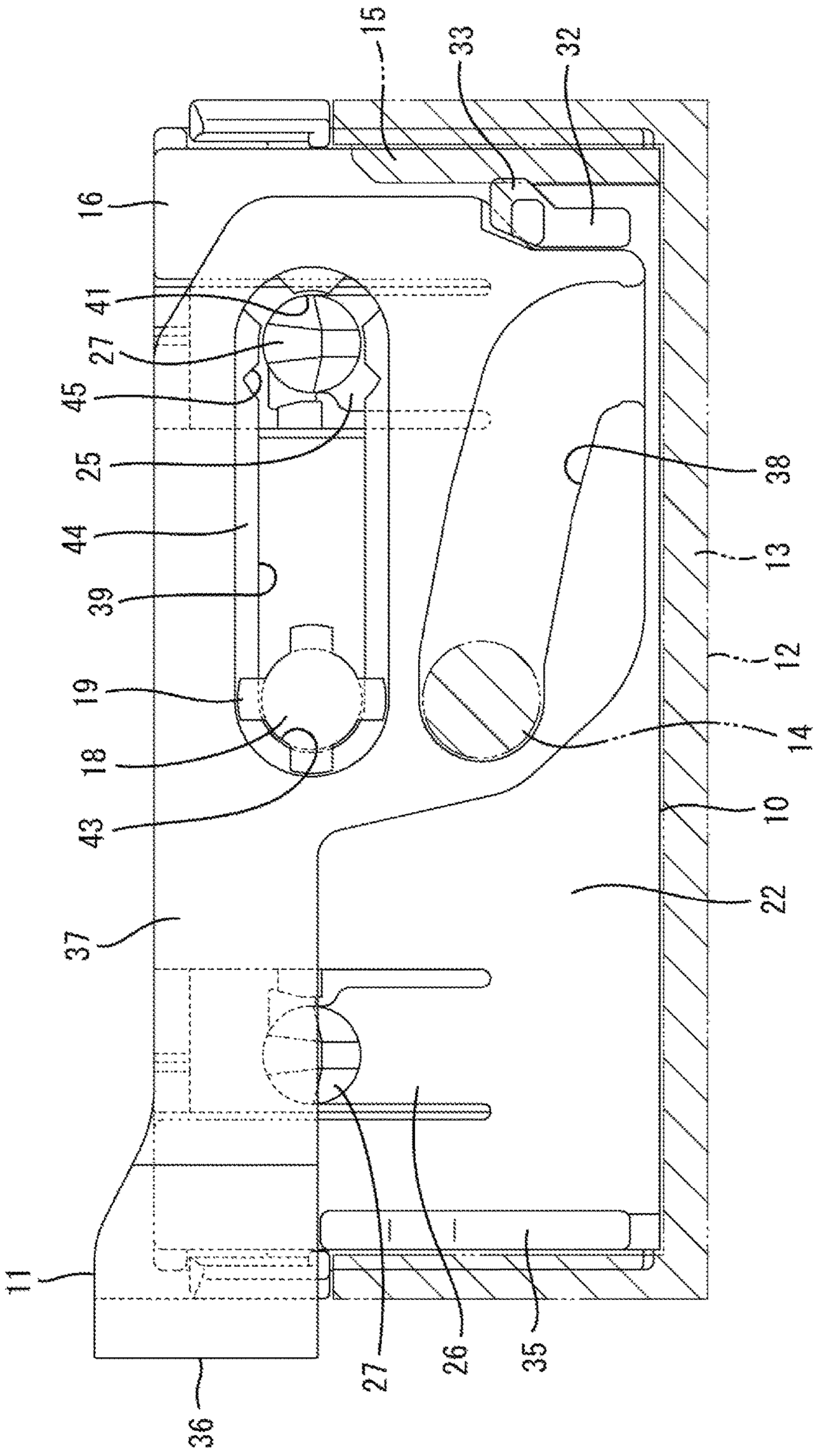
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FIG. 10

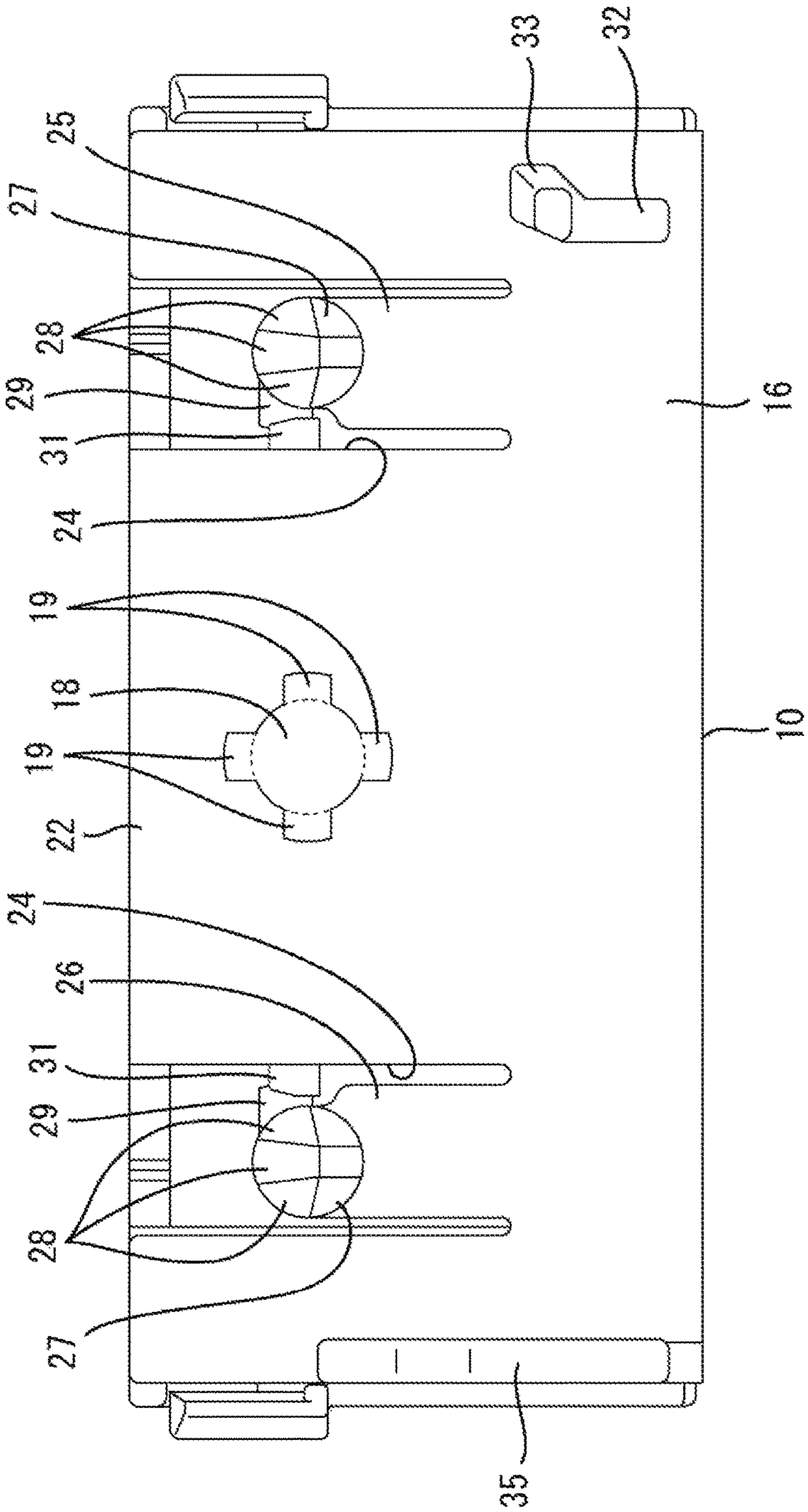

FIG. 11

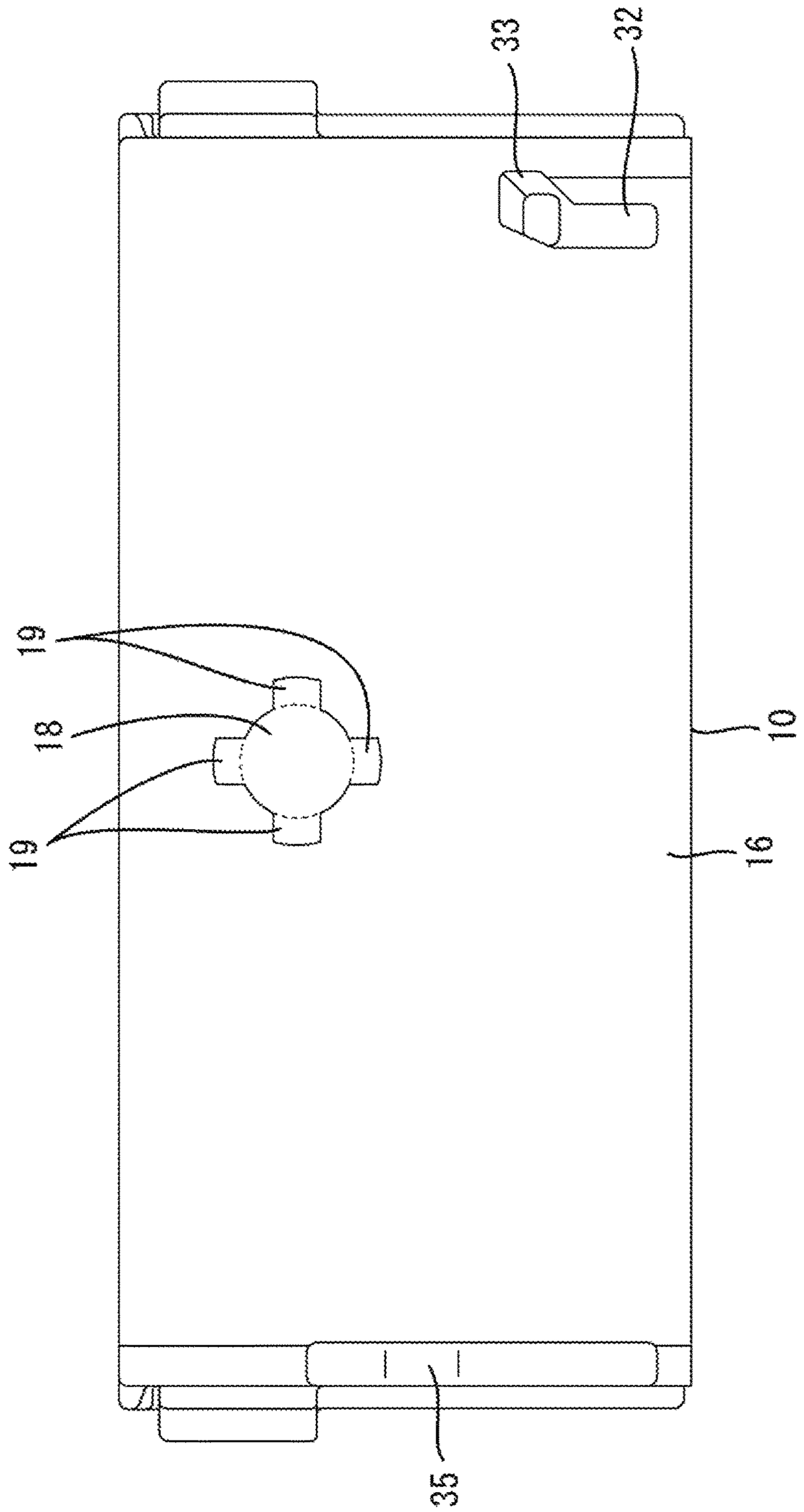

FIG. 12

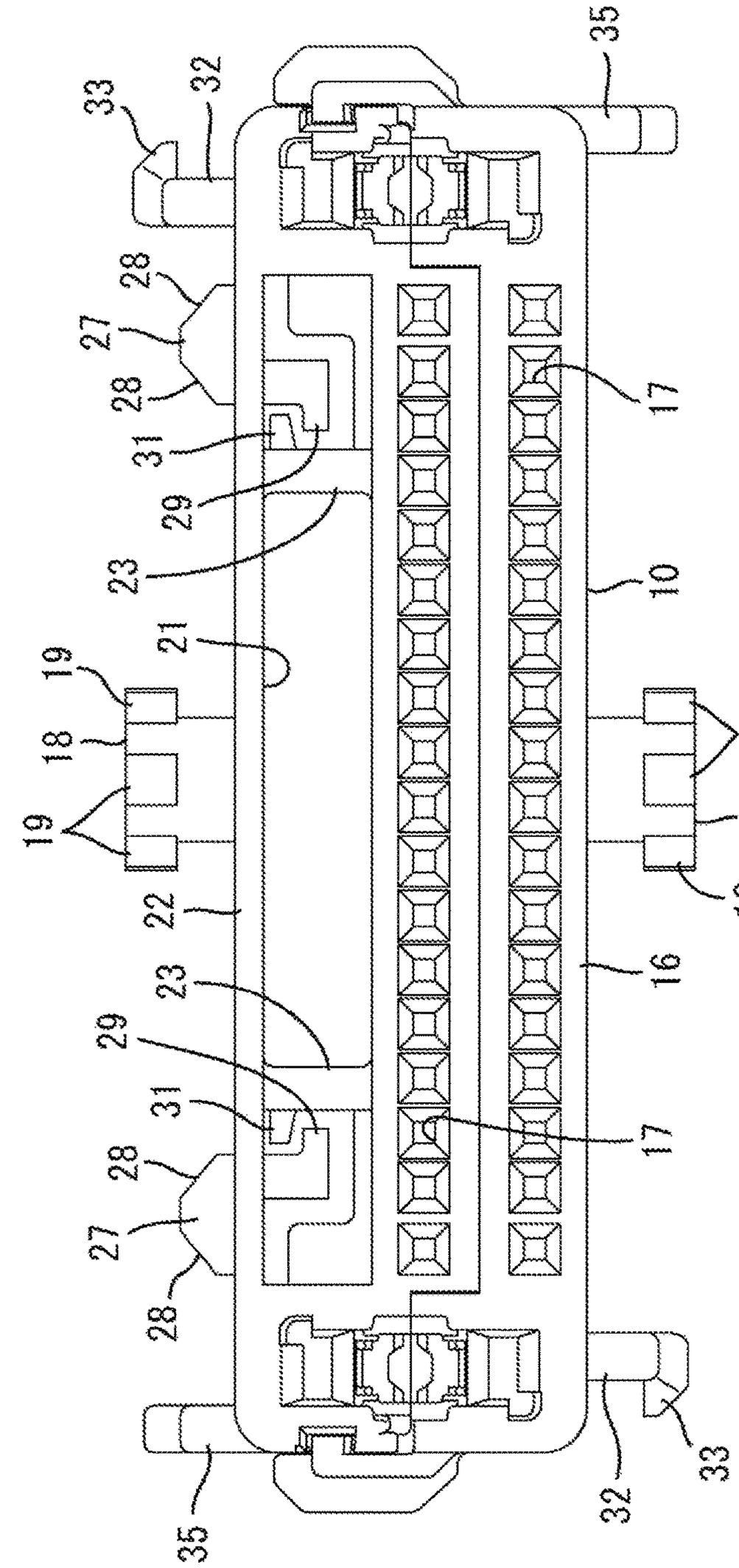
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FIG. 13

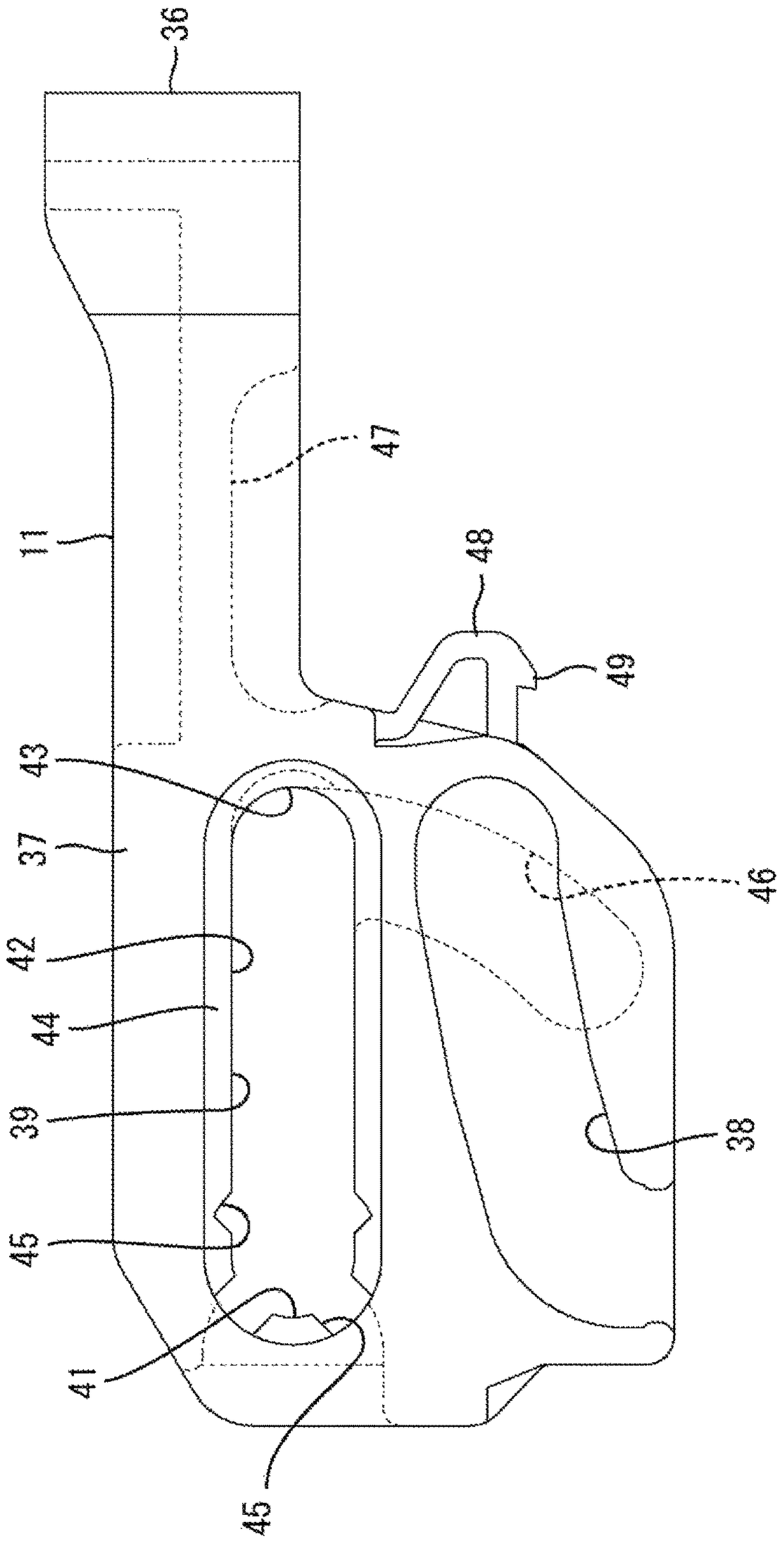
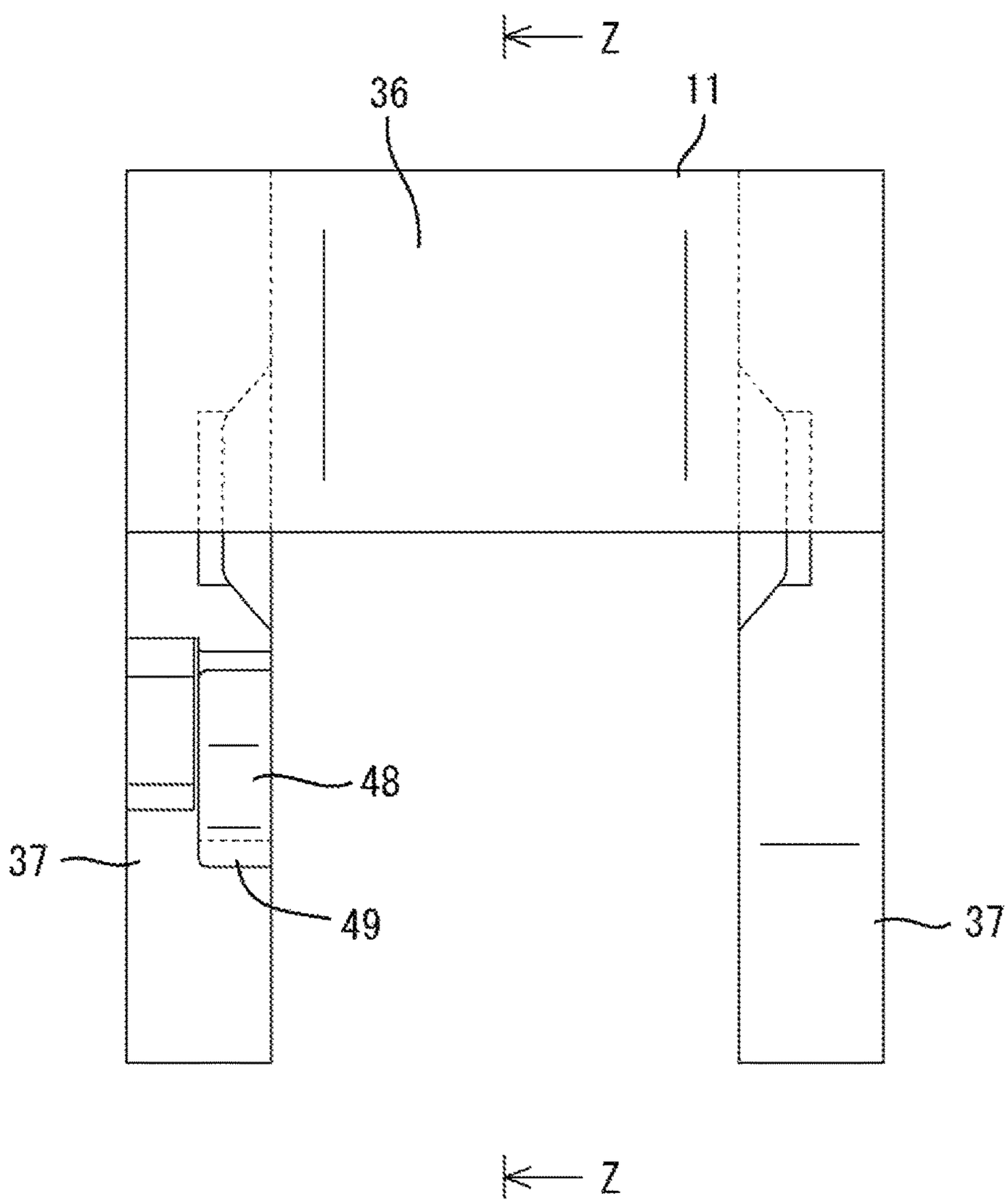


FIG. 14

FIG. 15



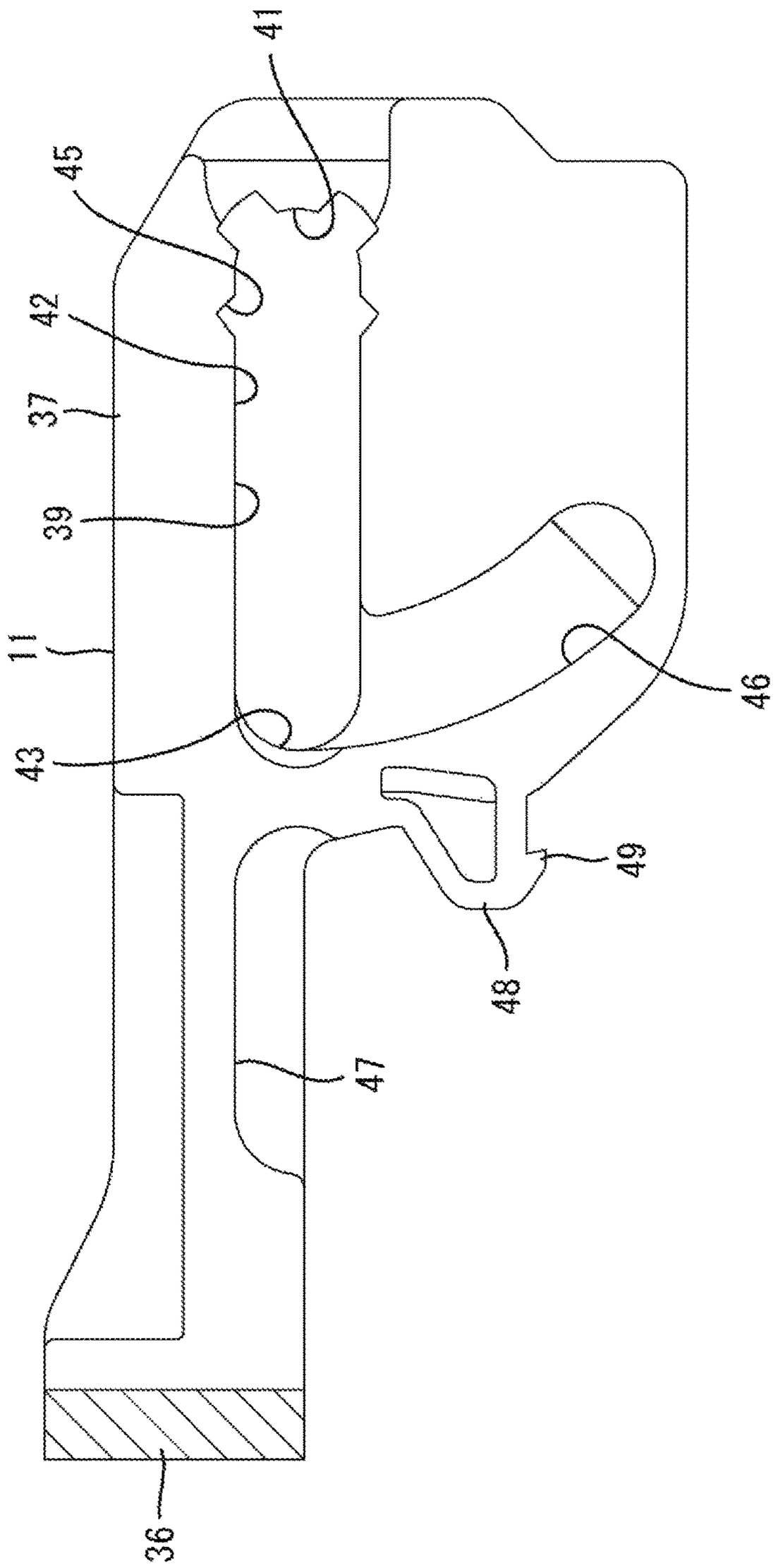


FIG. 16

CONNECTOR WITH LINEARLY MOVABLE OPERATING MEMBER THAT IS MOVABLE OPTIONALLY IN OPPOSITE FIRST AND SECOND MOVING DIRECTIONS FOR CONNECTING THE CONNECTOR TO A MATING CONNECTOR

BACKGROUND

1. Field of the Invention

The invention relates to a connector.

2. Description of the Related Art

Japanese Unexamined Patent Publication No. 2003-151682 discloses a connector with male and female housings that are connectable to each other, and a slider movably mounted on the female housing. The slider includes a coupling plate, and two sliding plates extend from the coupling plate to define a U-shape. Each sliding plate has a cam groove. The male housing includes a receptacle, and follower pins stand on outer surfaces of the receptacle. The female housing includes a tower, a skirt arranged on the outer periphery of the tower and covers arranged at upper and lower sides of the skirt. Insertion paths are provided between the covers and the skirt for receiving the sliding plates of the slider.

The sliding plates are inserted laterally into the insertion paths, and the slider is held at a retracted position prior to connecting the housings. The receptacle then is fit shallowly between the skirt and the tower of the female housing so that the follower pins enter the cam grooves. The slider then is pushed toward an advanced position. As a result the follower pins slide along edges of the cam grooves and generate a cam mechanism between the slider and the male housing to urge the housings toward a connected position. The housings are connected properly when the slider reaches the advanced position and the follower pins reach ends of the cam grooves in this way.

The coupling and adjacent parts of the slider project a large lateral distance from the housing when the slider is at the retracted position. Thus, the slider at the retracted position easily interferes with external matter a lateral side. As a result, the slider is kept at the advanced position and is transported to a site for connection to the male housing in a state where a lateral projecting amount of the slider is small. On the other hand, an operator can assemble the slider at an position different from the retracted and advanced positions and can displace the slider from the assembled position to the retracted position at the connecting operation site. However, if the assembled position is set separately from the retracted position and the housing is provided with locking means for keeping the slider at the retracted position and the assembled position, there is a problem of complicating a structure and making a mold structure cumbersome.

The invention was completed based on the above situation and aims to simplify a locking structure in a connector with an operating member displaceable to three positions with respect to a housing including an assembled position.

SUMMARY

The invention is directed to a connector with a housing that is connectable to a mating housing. The connector also has an operating member that is displaceable on the housing between an assembled position, an initial position and a connection position. The operating member is configured to generate a connecting operation of the housings by cam engagement with the mating housing when the slider is displaced from the initial position to the connection position. The housing includes a resilient lock configured to lock the operating member at the assembled position to restrict a displacement of the operating member from the assembled position toward the initial position. The resilient lock also locks the operating member at the initial position to restrict a displacement of the operating member in a return direction from the initial position to the assembled position.

According to the above configuration, the operating member can be assembled with the housing at the assembled position different from the initial position and the connection position. Thus, the resilient lock can lock and hold the operating member at both the initial position and the assembled position. Accordingly, a structure can be simplified as compared to the case where a locking structure is provided for each of the initial position and the assembled position.

The operating member may include a rotating mechanism configured to rotationally displace the operating member between the assembled position and the initial position and a sliding mechanism configured to linearly move and displace the operating member between the initial position and the connection position. However, in some embodiments, it may not matter which of the rotating mechanism and the sliding mechanism displaces the operating member between the assembled position and the initial position and between the initial position and the connection position.

The operating member may be linearly movable along the housing from the initial position to the connection position and a moving direction of the operating member from the initial position toward the connection position with respect to the housing may be selectable from a first movement path and a second movement path that are opposite to each other. The resilient lock may be composed of a first lock and a second lock paired at line-symmetrical positions with respect to a center of a length of the housing along the moving direction of the operating member. The first lock may lock the operating member at the initial position and the second lock may lock the operating member at the connection position when the operating member moves along the first movement path; and the second lock may lock the operating member at the initial position and the first lock may lock the operating member at the connection position when the operating member moves along the second movement path. According to this configuration, the movement path of the operating member from the initial position toward the connection position is selectable from the first and second movement paths. Thus, the movement path of the operating member can be determined depending on an installation situation and usefulness is enhanced. Further, the resilient lock may be composed of the first and second locks, and locking means for keeping the operating member at the initial position and the connection position are realized by the first and second locks and are not doubled as compared to the case where the operating member moves only in one direction. Thus, the structure can be simplified.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a plan view of a connector of one embodiment showing a state where an operating member is at an assembled position with respect to a housing.

FIG. **2** is a plan view showing a state where the operating member is at an initial position with respect to the housing and facing a mating housing.

FIG. **3** is a section along X-X of FIG. **2**.

FIG. **4** is a side view showing the state where the operating member is at the initial position with respect to the housing.

FIG. **5** is a section along Y-Y of FIG. **4**.

FIG. **6** is a view, corresponding to FIG. **5**, showing a state where the mating housing is connected shallowly and a resilient piece and a lock receiving portion are unlocked by an unlocking portion of the mating housing.

FIG. **7** is a view, corresponding to FIG. **5**, showing a state where the operating member is at a connection position with respect to the housing.

FIG. **8** is a plan view showing the state where the operating member is at the connection position with respect to the housing.

FIG. **9** is a plan view showing a state where the operating member is at the initial position in an orientation opposite to that in FIG. **2** with respect to the housing.

FIG. **10** is a plan view showing a state where the operating member is at the connection position in an orientation opposite to that in FIG. **8**.

FIG. **11** is a plan view of the housing.

FIG. **12** is a bottom view of the housing.

FIG. **13** is a front view of the housing.

FIG. **14** is a plan view of the operating member.

FIG. **15** is a side view of the operating member.

FIG. **16** is a section along Z-Z of FIG. **15**.

DETAILED DESCRIPTION

An embodiment of the invention is described with reference to FIGS. **1** to **16**. A connector of this embodiment includes a housing **10** and an operating member **11**. The housing **10** is connectable to a mating housing **12**. Note that, in the following description, end of the housings **10**, **12** that face each other at the start of connection are referred to as front end concerning a front-rear direction. A vertical direction is based on FIG. **13** and equivalent to a direction perpendicular to the plane of FIG. **1**. Further, a lateral direction is based on FIG. **1**.

The mating housing **12** is made of synthetic resin and includes a rectangular tubular receptacle **13** that is long and narrow in the lateral direction, as shown in FIG. **2**. Cylindrical cam followers **14** project on laterally central parts of inner surfaces of upper and lower walls extending along a long side direction. Unlocking ribs **15** are provided on one lateral end part of the inner surface of each of the upper and lower walls and extend in the front-rear direction. Tabs of unillustrated male terminal fittings project in the receptacle **13**.

The housing **10** is made of synthetic resin and includes a housing body **16**, as shown in FIGS. **11** to **13**. The housing body **16** is a wide rectangular block that is configured to fit into the receptacle **13**. As shown in FIG. **13**, cavities **17** penetrate through the housing body **16** in the front-rear direction. The cavities **17** are arranged side by side in a width direction in upper and lower stages, and unillustrated female terminal fittings are inserted and held therein. Each female terminal fitting is crimped and connected to an end part of an unillustrated wire and is connected conductively to the mating male terminal fitting when the housings **10**, **12** are connected properly.

Cylindrical support shafts **18** project in laterally central parts of both upper and lower surfaces of the housing body **16**. Four circumferentially spaced jaws **19** protrude radially from a tip of a cylindrical part of each support shaft **18**. Each jaw **19** is rectangular in a plan view, and the jaws **19** are arranged at intervals of 90° to the front, rear, left and right of the tip of the cylindrical part.

As shown in FIG. **13**, a wide flat space **21** penetrates through the housing body **16** in the front-rear direction at a position above the respective cavities **17**, and a flat and plate-like thin wall **22** extending in the lateral direction is provided to close an upper side of the space **21**. Further, the interior of the space **21** is divided by separation walls **23** disposed on both left and right sides.

As shown in FIG. **11**, cutout grooves **24** are provided on left and right end parts of the thin wall **22**. The grooves **24** extend in the front-rear direction and are open on a rear end while communicating with the space **21**. An inner edge of the groove **24** is continuous with a surface of the separation wall **23**. Plate shaped resilient locks **25** and **26** are cantilevered rearward from both left and right parts of the thin wall **22** between a pair of the grooves **24**. The resilient locks **25**, **26** are deflectable and deformable vertically with the front ends serving as supports.

As described later, the resilient locks **25**, **26** have a function of locking and holding the operating member **11** on the housing **10** in a movement restricted state, and define a first lock **25** (right side of FIG. **11**) and a second lock **26** (left side of FIG. **11**). The first and second locks **25**, **26** are line-symmetrically shaped and are arranged at line-symmetrical positions across a laterally central part of the housing body **16** on opposite sides of the support shafts **18**. Note that, in the following description, unless it is particularly necessary to distinguish the first and second locks **25**, **26**, the first and second locks **25**, **26** are referred to collectively as the resilient locks **25**, **26**.

As shown in FIG. **11**, rear ends of the plates of the resilient locks **25**, **26** are forward from the rear end of the housing **10**. Lock projections **27** project up on rear ends of the plates of the resilient locks **25**, **26**. Each lock projection **27** is circular in a plan view and has tapered slopes **28** inclined up toward a tip in a projecting direction on rear and both left and right surfaces. The lock projections **27** are arranged laterally side by side at the same position as the support shafts **18** in the front-rear direction.

As shown in FIG. **13**, excessive deflection restricting pieces **29** are provided on the tip parts of the plates of the resilient locks **25**, **26** and projecting down in the space **21**. Each excessive deflection restricting piece **29** has a vertical part hanging down from the plate and a horizontal part bent at a right angle from the lower end of the vertical part toward the separation wall **23** to define an L-shaped in a front view.

An excessive deflection restriction receiving piece **31** projects above the horizontal part of the excessive deflection restricting piece **29** on the surface of the separation wall **23**. The excessive deflection restriction receiving piece **31** is at a predetermined distance from and parallel to the excessive deflection restricting piece **29**. The resilient lock **25**, **26** is deflected and deformed up and the excessive deflection restricting piece **29** contacts the excessive deflection restriction receiving piece **31** from below to prevent further deflection of the resilient lock **25**, **26**. Thus, even if the resilient lock **25**, **26** is caught by external matter, such as a looped wire, the resilient lock **25**, **26** cannot be turned out and broken. Note that, as shown in FIG. **11**, a side edge part of a tip part of the resilient lock **25**, **26** on the side of the separation wall **23** (on the side of the support shaft **18**) is cut due to the molding of the excessive deflection restriction receiving piece **31**.

As shown in FIG. **13**, a lock receiving portion **32** is provided on one lateral end of each of the upper and lower surfaces of the housing body **16**. Two of the lock receiving portions **32** are point-symmetrically shaped and are at point-symmetrical positions with respect to a center of the housing body **16** (axial center when the housing body **16** is viewed from the front). As shown in FIG. **11**, each lock receiving portion **32** includes a rib-like part extending in the front-rear direction and is arranged in front of and laterally to the resilient locks **25**, **26** (right side of FIG. **11**). A space into which the unlocking portion **15** of the mating housing **12** is inserted when the both housings **10**, **12** are connected is secured laterally to the lock receiving portion **32**.

As shown in FIGS. **11** to **13**, the lock receiving portion **32** has a receiving piece **33** bent and protruding rearward and laterally on a rear end side of a tip part of the rib-like part in a projecting direction. As shown in FIG. **4**, an insertion recess **34** is defined between the receiving piece **33** and the rib-like part and receives a later-described locking projection **49** of the operating member **11**.

As shown in FIG. **13**, a stopper **35** is provided on the other lateral end of each of the upper and lower surfaces of the housing body **16** and is in the form of a plate extending in the front-rear direction. The two stoppers **35** are shaped point-symmetrically at point-symmetrical positions with respect to the center of the housing body **16**. As shown in FIG. **11**, the stoppers **35** are longer in the front-rear direction than the lock receiving portions **32** and arranged along side surfaces of the housing body **16**. As shown in FIG. **4**, the rear end of each stopper **35** protrudes in the vertical direction and is arranged perpendicularly. As described later, the operating member **11** can be stopped at an initial position in contact with the stopper **35**.

The operating member **11** is made of synthetic resin, and includes a coupling **36** and two arms **37** projecting parallel to each other from ends of the coupling **36** to define a U-shape, as shown in FIG. **15**. This operating member **11** is displaceable, with respect to the housing **10**, from an assembled position (see FIG. **1**), the initial position (see FIG. **2**) and a connection position (see FIG. **8**). The arms **37** project obliquely rearward at an angle of inclination of about 45° with respect to the front-rear direction and the lateral direction when the operating member is in the assembled position (FIG. **1**). The arms **37** project large amounts laterally of the housing **10** along the lateral direction when the operating member is in the initial position (FIG. **2**). The arms **37** project slightly laterally of the housing **10** along the lateral direction or are arranged without projecting when the operating member **11** is in the connection position (FIG. **8**)

The operating member **11** includes a rotating mechanism and a sliding mechanism. The rotating mechanism is configured to displace the operating member **11** rotationally from the assembled position to the initial position with respect to the housing **10** to gradually increase a laterally projecting amount toward the initial position. The sliding mechanism is configured to displace the operating member **11** linearly in the lateral direction along the housing **10** from the initial position to the connection position to gradually decrease the laterally projecting amount toward the connection position. Further, a movement path of the operating member **11** can be selected from a first movement path (see arrow A of FIG. **2**) and a second movement path (see arrow B of FIG. **9**). With the first movement path (arrow A of FIG. **2**), the operating member **11** moves from the side of the first lock **25** toward the side of the second lock **26**. With the second movement path (arrow B of FIG. **9**), the operating member **11** is inverted vertically from a moving posture along the first movement path and moves from the side of the second lock **26** toward the side of the first lock **25** when the operating member **11** is moved toward the connection position by the sliding mechanism.

The coupling **36** is a plate extending in the vertical direction and an operator can grip the coupling **36** by the fingers.

As shown in FIG. **14**, a side of each of the arms **37** distant from the coupling **36** forms a flat plate-shaped body expanded in the front-rear direction, and a cam groove **38** is provided in the body. The cam groove **38** is a bottomed groove formed by recessing an outer surface of the body of the arm **37**, extends in a curved manner and is open on the front end edge of the body. The cam groove **38** engages the cam follower **14** of the mating housing **12** to proceed with the connecting operation of the housings **10**, **12** when the operating member **11** moves from the initial position to the connection position.

A linearly extending long groove **39** is provided in an area of the body of each of the arms **37** behind the cam groove **38**. The long groove **39** penetrates through the arm **37** in a plate thickness direction and is arranged along the lateral direction when the operating member **11** is at the initial position and the connection position. The support shaft **18** is inserted into the long groove **39** and slides in contact with an engaging edge **44** of the long groove **39** to guide a moving operation of the operating member **11** when the operating member **11** moves between the initial position and the connection position.

The long groove **39** receives the support shaft **18** at an end **41** distant from the coupling **36** (see FIG. **1**) and can slide in contact with the support shaft **18** in an extending portion **42** that linearly extends from the end **41** toward the coupling **36**. The engaging edge **44** extends along the edge of the long groove **39** in the plate thickness direction of the arm **37** to face the housing body **16** and protrudes over the entire periphery except at escaping recesses **45** to be described later. As shown in FIG. **8**, the engaging edge **44** protrudes slightly less than the jaws **19** of the support shaft **18**. The engaging edge **44** slides in contact with the jaws **19** of the support shaft **18** inserted into the long groove **39** from inside except at the initial position and restricts outward expanding deformation (opening deformation) of the arm **37**.

As shown in FIGS. **1** and **14**, the end **41** of the long groove **39** is provided with the escaping recesses **45** by partially cutting off the engaging edge **44**. The escaping recesses **45** have a rectangular or triangular cross-sectional shape so that the jaws **19** are fittable inside. When the operating member **11** is arranged at the assembled position and the arms **37** are inclined at 45°, the escaping recesses **45** are open at intervals of 90° on front, rear, left and right sides of the engaging edge **44**.

As shown in FIG. **16**, a bottomed guide groove **46** is provided on the inner surface of the body part of each of the arms **37** and extends forward from an end **43** of the long groove **43** on the side of the coupling **36**. The guide groove **46** is shallower than the cam groove **38**. When the operating member **11** is displaced rotationally between the assembled position and the initial position, the lock projection **27** of the resilient lock **25**, **26** is inserted into the guide groove **46** to be slidable in contact with the guide groove **46**. The guide groove **46** is curved along an arc centered on a center of rotation of the operating member **11**.

A bottomed escaping groove **47** is provided in an inner surface of a plate that connects the body part and the coupling **36** in each of the arms **37**. The escaping groove **47** is arranged at the same position as the long groove **39** in the

front-rear direction, extends in the lateral direction and is open on the front end edge of the plate of the arm **37**. The lock projection **27** of the resilient lock **25**, **26** is inserted into the escaping groove **47** to be allowed to escape when the operating member **11** moves between the initial position and the connection position.

A resilient piece **48** is provided on one **37** of the arms **37** and projects laterally toward the coupling **36** along a plate surface of the arm **37** from an outer edge of the body part. The resilient piece **48** is curved to form a U-shaped beam with both ends coupled to the body of the arm **37**, and is thinner than the body of the arm **37**. A claw-like locking projection **49** projects forward on a tip part of the U-shaped central part) of the resilient piece **48** in a projecting direction.

Next, functions of the connector are described.

The operating member **11** is separated from the housing **10** for transportation to a connector assembly site. The terminal fittings are inserted into the cavities **17** of the housing **10** at the connector assembly site and then the operating member **11** is assembled with the housing **10** at the assembled position (see FIG. **1**). During assembly, the operating member **11** is pushed to straddle the housing **10** obliquely from the rear. Then, after both arms **37** are expanded, the escaping recesses **45** of the long grooves **39** pass through the jaws **19** of the support shafts **18** and the support shafts **18** are fit into the ends **41** of the long grooves **39**.

The lock projection **27** of the first lock **25** is inserted into the guide groove **46** of the arm **37** when the operating member **11** reaches the assembled position. At this time, the lock projection **27** contacts a front end part of the guide groove **46** to restrict a rotational displacement of the operating member **11** in a direction away from the initial position (see FIG. **1**). Note that the operator can continuously perform a series of operations while gripping the coupling **36** of the operating member **11**.

Subsequently, the operating member **11** is rotated about the support shafts **18** that have been inserted into the ends **41** of the long grooves **39** to move in a clockwise direction of FIG. **1** from the assembled position toward the initial position. The rear slope **28** of the lock projection **27** slides in contact with the back surface of the guide groove **36** and the first lock **25** is deformed while the operating member **11** is rotated. Large resistance is not applied to the operating member **11** from the side of the housing **10**. Further, as the operating member **11** is rotated from the assembled position toward the initial position, the engaging edges **44** of the long grooves **39** slide in contact with the jaws **19** of the support shafts **18** from inside, thereby restricting detachment of the arms **37** from the support shafts **18**.

When the operating member **11** reaches the initial position, the first lock **25** is displaced resiliently in a return direction and the lock **27** is transferred and inserted into the other end **43** of the long groove **39** from the guide groove **46** (see FIG. **3**). The engaging edge **44** of the long groove **39** contacts the lock projection **27** from the front to restrict rotation of the operating member **11** in the return direction toward the assembled position. Further, the plate of the arm **37** on the side where the resilient piece **48** is not provided is stopped in contact with the rear end of the stopper **35**, thereby restricting further rotation of the operating member **11** beyond the initial position (see FIG. **4**).

When the operating member **11** reaches the initial position, the locking projection **49** of the resilient piece **48** is arranged for laterally contacting the rear end of the rib-like part of the lock receiving portion **32**, thereby restricting movement of the operating member **11** from the initial position toward the connection position (see FIG. **5**). At this time, the locking projection **49** of the resilient piece **48** is fit into the insertion recess **34** at an inner side of the receiving piece **33** (see FIG. **4**). In this way, the receiving piece **33** protects the locking projection **49** and ensures that external mater does not interfere with the locking projection **49** to inadvertently unlock the locking projection **49** from the lock receiving portion **32**. Further, the support shafts **18** are kept inserted in the ends **41** of the long grooves **39** and can contact the ends **41** at the initial position. Thus, a movement of the operating member **11** in a direction opposite to that toward the connection position is also restricted (see FIG. **2**).

In the above state, the receptacle **13** of the mating housing **12** is fit shallowly to the housing **10** and the cam followers **14** enter the cam grooves **38** (see FIG. **6**). Further, the unlocking portion **15** presses the tip of the resilient piece **48** in the projecting direction so that the resilient piece **48** is deformed to incline rearward while extending along a plate surface direction of the arm **37**. In this way, the locking projection **49** is separated from the rib-like part of the receiving piece **32** to unlock the resilient piece **48** and the receiving piece **32** from each other and enable the operating member **11** to be moved to the connection position. Further, deforming the resilient piece **48** along the inner surface of the receiving piece **33** ensures that interference of the resilient piece **48** and the receiving piece **33** is avoided.

The operating member **11** then is moved linearly toward the connection position (side where the second lock **26** is located) along the first movement path. In an initial stage of moving the operating member **11** toward the connection position, the arm **37** slides on the lateral slope **28** of the lock projection **27** and the first lock **25** is deflected and deformed inwardly. When the operating member **11** is moved further toward the connection position, the lock projection **27** enters the escaping groove **47** and escapes so that the first lock **25** is returned resiliently to a natural state.

In the process of moving the operating member **11** along the first movement path, the support shafts **18** are displaced relative to the long grooves **39** in a direction away from the ends **41** and the jaws **19** at the front and rear sides of the support shafts **18** slide in contact with the engaging edges **44** of the long grooves **39** from outside. In this way, a movement of the operating member **11** is guided. Further, in the process of moving the operating member **11**, the cam followers **14** of the mating housing **12** slide in contact with the edges of the cam grooves **38**, a cam mechanism acts between the operating member **11** and the mating housing **12**, and the connecting operation of the housings **10**, **12** proceeds with a low connecting force. During this time, the arms **37** of the operating member **11** may deform out and away from the outer surfaces of the housing body **16** due to connection resistance. However, the engaging edges **44** of the long grooves **39** contact the front and rear jaws **19** from inside to restrict expanding movements of the arms **37**. As a result, the arms **37** cannot deform and detach from the housing **10**.

In a stage immediately before the operating member **11** reaches the connection position, the tip of the arm **37** in a moving direction slides on the lateral slope **28** of the lock projection **27** of the second lock **26** and the second lock **26** is deflected inward. When the operating member **11** reaches the connection position, the second lock **26** is displaced resiliently in a return direction and the lock projection **27** is inserted into the end **41** of the long groove **39** from inside (see FIG. **8**). At this time, the lock projection **27** contacts the end **41** of the long groove **39** in the lateral direction (moving

direction along the first movement path) to restrict movement of the operating member **11** in the return direction toward the initial position. Further, when the operating member **11** reaches the connection position, the support shafts **18** contact the other ends **43** of the long grooves **39** and the coupling **36** is arranged to contact the side surface of the housing **10**, thereby restricting further movement of the operating member **11** beyond the connection position. Furthermore, the lock projection **27** of the second lock **26** is arranged in the end **41** of the long groove **39** and the support shaft **18** is arranged in the other end **43** of the long groove **39** to restrict a rotational displacement of the operating member **11**. At the connection position, the cam followers **14** are located in final end parts of the cam grooves **38** and the housings **10**, **12** are connected properly.

On the other hand, a situation may arise in which the operating member **11** cannot be moved along the first movement path due to an interfering object to the right side of FIG. **2**. Thus, the operating member **11** at the initial position interferes with the interfering object. In this situation, it is selected to move the operating member **11** along the second movement path opposite to the first movement path.

In this case, the operating member **11** is inverted vertically and the coupling **36** is arranged on a left side of FIG. **9** and opposite to the side when the operating member **11** is moved along the first movement path with respect to the housing **10**. First, the operating member **11** is assembled at the assembled position. At the assembled position, the lock projection **27** of the second lock **26** is inserted into the guide groove **46** of the arm **37** and comes into contact with the front end part of the guide groove **46**, thereby restricting a rotational displacement of the operating member **11** in the direction opposite to that toward the initial position.

Subsequently, the operating member **11** is rotated counterclockwise about the support shafts **18** from the assembled position toward the initial position. When the operating member **11** reaches the initial position, the lock projection **27** of the second lock **26** is inserted resiliently into the other end **43** of the long groove **39** from inside and the engaging edge **44** of the long groove **39** contacts the lock projection **27** from the front to restrict a return displacement of the operating member **11** to the assembled position. Further, the plate of the arm **37** on the other side (side where the resilient piece **48** is not provided) is stopped in contact with the rear end of the stopper **35**, thereby restricting any further rotation of the operating member **11** beyond the initial position (see FIG. **9**). Furthermore, the locking projection **49** of the resilient piece **48** locks the lock receiving portion **32**, thereby restricting a movement of the operating member **11** to the connection position. In this case, the locking projection **49** locks the lock receiving portion **32** on the lower surface (surface where the resilient locks **25**, **26** are not provided) of the housing **10** on a side opposite to that when the first movement path is selected. Further, the stopper **35** to be stopped in contact with the arm **37** at the initial position is provided on the lower surface of the housing **10** when the first movement path is selected while being provided on the upper surface of the housing **10** when the second movement path is selected.

Subsequently, the housings **10**, **12** are connected shallowly and the cam followers **14** are inserted into the entrances of the cam grooves **38**. The resilient piece **48** then is pressed by the unlocking portion **15** and deflected rearwardly to move away from the lock receiving portion **32**, thereby enabling the operating member **11** to be moved to the connection position. Subsequently, the operating member **11** is moved linearly toward the connection position (side where the first lock portion **25** is located) along the second movement path. When the operating member **11** reaches the connection position, the lock projection **27** of the first lock **25** is inserted resiliently into the end **41** of the long groove **39** from inside and contacts the end **41** of the long groove **39** in a direction opposite to the return direction to the initial position, thereby restricting a return movement of the operating member **11** to the initial position (see FIG. **10**). Further, the lock projection **27** of the second lock **26** is inserted into the escaping groove **47** of the arm **37** and allowed to escape.

As just described, roles of locking functions of the first and second locks **25**, **26** at each of the initial position and the connection position are reversed when the operating member **11** is moved along the first movement path and when the operating member **11** is moved along the second movement path, but the locking functions themselves are the same.

As described above, each of the following effects can be achieved according to this embodiment.

Since the operating member **11** is rotated from the assembled position to the initial position and the laterally projecting amount of the housing **10** is suppressed at the assembled position than at the initial position, the operating member **11** is less likely to interfere with external matter intruding to a lateral side of the housing **10** at the assembled position. However, a transition is made from the rotating operation by the rotating mechanism to the linearly moving operation by the sliding mechanism at the initial position. Therefore, the operating member **11** does not stay long at the initial position and is less likely to interfere with external matter at the initial position. As a result, it is possible to prevent a situation in which the operating member **11** is moved inadvertently from the initial position to the connection position or broken due to interference with external matter.

Further, the arms **37** of the operating member **11** are not covered from outside by members, such as conventional covers. However, the expanding movements are suppressed by contact of the engaging edges **44** of the long grooves **39** with the jaws **19** of the support shafts **18** to prevent detachment from the housing **10**. Omitting the conventional covers avoids enlargement of the housing **10**. This is ensured by the arrangement of the operating member **11** in a state exposed on the outer surfaces without being covered by the housing **10**.

Further, the operating member **11** is moved linearly from the initial position to the connection position and one of the first and second movement paths can be selected depending on an installation situation and usefulness is enhanced. In addition, the locking means for keeping the operating member **11** at the initial position and the connection position are realized by the first lock **25** and the second lock **26**, and four locking means corresponding to each movement path and each position are not provided. Thus, a structure can be simplified. In this case members such as the conventional covers configured to cover the operating member **11** are not present on the outer surfaces of the housing **10**, and a mold removal structure in molding the first and second locks **25**, **26** on the outer surface of the housing **10** needs not be complicated.

When the operating member **11** is moved linearly with respect to the housing **10**, the engaging edges **44** of the long grooves **39** slide in contact with the support shafts **18** to guide a movement of the operating member **11**. The long grooves **39** guide a movement of the operating member **11**, restrict a movement of the operating member **11** by being

locked by the resilient locks **25**, **26** and suppress the opening deformation of the operating member **11** by causing the jaws **19** of the support shafts **18** to contact the engaging edges **44**. Thus, as compared to the case where each function is individually provided, the structure of the operating member **11** can be simplified.

The resilient lock **25**, **26** restricts a displacement of the operating member **11** in the direction opposite to that from the assembled position toward the initial position by locking the lock projection **27** to the front end of the guide groove **46** when the operating member **11** is at the assembled position and restricts a displacement of the operating member **11** in the return direction from the initial position to the assembled position by locking the lock projection **27** to the other end **43** of the long groove **39** when the operating member **11** is at the initial position. Thus, the operating member **11** is locked and held to the resilient lock **25**, **26** both at the initial position and at the assembled position and it is not necessary to provide the locking structure for each of the initial position and the assembled position. Therefore, the structure can be simplified.

Further, the unlocking portion **15** of the mating housing **12** presses the resilient piece **48** when the operating member **11** is at the initial position so that the resilient piece **48** is deflected and deformed in the direction along the plate surface of the arm **37** to be unlocked from the lock receiving portion **32** and the operating member **11** is in a state displaceable toward the connection position. In this case, a locking margin of the resilient piece **48** to the lock receiving portion **32** is determined in the direction along the plate surface of the arm **37**. Thus, a degree of freedom in setting the locking margin is high and a sufficiently large locking margin can be set. As a result, the locking strength of the operating member **11** at the initial position can be enhanced.

Further, the resilient piece **48** is a beam supported on both ends coupled to the body of the arm **37**. Therefore, external matter, such as a looped wire is less likely to be caught by the arm **37** and the deflection strength of the arm **37** can be enhanced.

The lock receiving portions **32** to be locked by the resilient piece **48** are provided on the outer surfaces of the housing **10** and members such as the conventional covers are not present on the outer surfaces of the housing **10**. Accordingly, a mold removal structure in molding the lock receiving portions **32** needs not be complicated.

Other embodiments are described below.

Contrary to the above embodiment, the support shafts may be provided on the inner surfaces of the arms of the operating member, the long grooves may be be open in the outer surfaces of the housing and the support shafts may be inserted into the long grooves from outside to be slidable in contact with the long grooves.

The long grooves may have a bottomed shape.

The shape and the number of the jaws on the support shaft are arbitrary and the escaping recesses may be provided to correspond to the jaw portions.

The housing may include a wire cover to cover the rear surface of the housing when the wires connected to the terminal fittings are pulled out rearwardly of the housing. Thus, the support shafts, the lock receiving portions and the resilient locks may be provided on the wire cover.

LIST OF REFERENCE SIGNS

10 . . . housing
11 . . . operating member
12 . . . mating housing
15 . . . unlocking portion
18 . . . support shaft
19 . . . jaw
25 . . . first lock
26 . . . second lock
27 . . . lock projection
32 . . . lock receiving portion
36 . . . coupling
37 . . . arm
38 . . . cam groove
39 . . . long groove
41 . . . end of long groove
44 . . . engaging edge portion
46 . . . guide groove
48 . . . resilient piece
49 . . . locking projection

What is claimed is:

1. A connector, comprising:

a housing connectable to a mating housing;

an operating member that is linearly movable along the housing between an initial position and a connection position and being configured to proceed with a connecting operation of the housing and the mating housing by cam engagement with the mating housing as the operating member is displaced from the initial position to the connection position, a moving direction of the operating member from the initial position toward the connection position with respect to the housing is selectable from those along a first movement path and a second movement path opposite to each other;

a first lock and a second lock paired at line-symmetrical positions with respect to a center of a length of the housing along the moving direction of the operating member;

the first lock resiliently locks the operating member at the initial position and the second lock resiliently locks the operating member at the connection position when the operating member moves along the first movement path; and

the second lock resiliently locks the operating member at the initial position and the first lock resiliently locks the operating member at the connection position when the operating member moves along the second movement path.

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